Ergotic / epistemic/ semiotic action-perception loops

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The typology of the functions of human-environment interaction proposed by Cadoz [→ Ergotic / epistemic / semiotic functions] allows drawing out an operational categorization of the implied sensori-motor loops in two complementary categories, according to whether there is or not an energetic structural relation (or energetic consistency) between the actions and the perceived resulting phenomena. Two categories can be distinguished:

- ergotic interaction loops;
- pure epistemic-semiotic loops or non-ergotic interaction loops.

The distinction is operational in the sense that it leads to clearly-cut complementary categories among the technological tools and systems needed to support interaction between human and his/her external universe.

Pure epistemic-semiotic interaction loops

For a human subject, epistemic reception and semiotic emission of information can be linked, constituting an action-perception loop.

In a pure epistemic-semiotic interaction loop, emission of information from the human subject (to the world) and reception of information by the human subject (from the world) are correlated but without structural energy exchanges, in the sense that the energy made to perform the action is not necessarily engraved in the epistemic sensory feedbacks.

Possible epistemic-semiotic loops are:

- Loop from semiotic gesture action to epistemic seeing. That is the case when one speaks about "seen expressive gesture" or "seen non-verbal gesture".
- Loop from semiotic gesture action to epistemic hearing. That is the case when one speak about "heard expressive gesture" or "heard non-verbal gesture"
- Loop from semiotic gestural action (free gestures, facial movements, etc.) to epistemic gesture perceptions. This is the case of cutaneous touch in which there is any noticeable muscular energetic activity in the result of the action.
- Loop from voice to seeing and hearing.

Examples of epistemic-semiotic loops are: pointing an object, moving to see or to hear, reading, navigating in a data base or in a virtual environments by means of non retroactive sensors as sticks, mouse, triggering a sound signals by acting on a non-retroactive transducer, selecting an object or an icon, conducting an orchestra, etc.

In these action-perception loops, perception depends obviously on action. However, the physical states of the interacting bodies are not modified by the interaction process. These llops are not action-perception loops aiming to act on the world. Mainly they are rather exploratory activities oriented toward acquiring a knowledge of the world, or symbolic activities oriented toward symbolic constructions.

In epistemic-semiotic loops, the muscular energetic activity and the energetic exchanges (if any) can be neglected, or mediated by tools that decrease it, without a noticeable loss in the performance of the task.

Ergotic interaction and its multisensory epistemic feedbacks

Ergotic interaction can be clearly distinguished from pure non-ergotic epistemic/semioyic interaction loops. The cases of the ergotic function, in which the human-environment interaction corresponds with energy exchanges between the interacting

bodies during the interaction, cannot be apprehended by pure epistemic-semiotic loops.

The relevant criteria to distinguished purely epistemic-semiotic loops from Ergotic cases is not the energy spent by the subject during the action, but the energy exchanged between the two interacting bodies, ie, the energy transferred from (resp. to) human to (resp. from) object, which is necessary to physically modify the world, on which the subject is interested in.

As an example, all the handling activities fall in such category, since they imply an energy exchange: grasping, pushing, pulling, cutting, throwing, carrying, moulding, hitting, rubbing, breaking, displacing an infinitely heavy object, writing, digging over the ground, moulding the paste of the bread, crumpling a paper sheet, playing violin, etc.

When one manipulates an object through ergotic interaction, the physical states of both object and subject are modified by the interaction. New mechanical behaviours depending on the interaction (sounds, deformations, fractures, etc…) are exhibited. Thus, the sensory epistemic feedbacks (mainly sight and hearing) inform the subject of the behavioural answers of the object in response to his gestural actions. The sensory stimuli can no more be considered by themselves (as conventionally considered by multimodality). They are due to the physical responses to the interaction, and are not exhibited by the object in the absence of the interaction.

Hence, the sensory stimuli, visual, acoustical or tactile-kinaesthetic, encode the coupled system made of the human body and the physical object. They inform the subject on the physical objects, but also on its physical coupling to the human body. For example, sounds encode the human/object system during the performance, visible motions (displacements and deformations) encode of the human/object system during the manipulation, etc.

In other words, during ergotic interaction, we can state that the physical object transforms the gesture space in auditory (resp. visual) space. Hence, the physical object transforms – or encodes - the gesture space in auditory (resp. visual) space.

During ergotic interaction, the sensorial space:

- Is intrinsically multisensorial: composed of ergotic interaction (with its action and perception part) and acoustical and/or visual feedbacks.
- Aims at knowing the coupled system object-subject, and not only at acquiring information on the object itself.

This means that:

- The object is known through the sensory feedbacks of the matter in response to the gesture actions.
- All these sensory feedbacks have to be considered a priori as an encoding of the couple human-object. They encode invariants of this coupled system (if they exist) to our cognition.
- All the sensory feedbacks are then physically, energetically coherent in their relation to the actions and in their interrelation.

To conclude

Ergotic situation correspond with two necessary features:

- The interaction correspond with the ergotic function
- The relation between all the sensory feedbacks and the gesture exhibits an energetic consistency.

Such type of interaction is called instrumental interaction [Cadoz, 94] [Wanderley, 00] [→ Instrumental interaction].

These two features impact the technology to use when willing to implement instrumental interaction with computers:

- For ergotic loop, there is a structural necessity to introduce force feedbacks and modelling methods based on physics and dynamics, able to correlate all the variables (positions, forces, visual deformations, acoustical deformations) in a spatio-temporal consistent scheme.

- For non-ergotic pure epistemic/semiotic loop, conversely, it is not necessary to introduce force feedbacks nor the correlated methods of modelling based on physics and dynamics. Others types of correlations (symbolic, signal-based, etc..) are most often sufficient to explore the wideness of all the possibilities of these type of interactions.

References

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Related items

Ergotic / epistemic / semiotic functions
Gesture, expressive
Gesture, non-verbal
Instrumental interaction
Interface, ergotic